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DEPARTMENT OF COMMERCE

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OF THE BUREAU OF STANDARDS

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BUREAU OF STANDARDS JOURNAL OF RESEARCH

There has just been issued the first number of a new monthly periodical, the "Bureau of Standards Journal of Research." This journal continues the publication of the two series of research papers heretofore issued—"Scientific Papers" and "Technologic Papers." Forty-four volumes (22 of each of the two superseded series) have been published, comprising 942 research papers (372 on fundamental and 370 on applied science).

The new journal will contain the bureau's research papers and critical reviews in the fields of science and technology. These will be comparable in

interest and importance with the scientific and technologic papers already issued. The union of pure and applied science in one journal will, it is believed, tend to shorten the lag between discovery and its application.

Everyone engaged in scientific or technical work should have available for current use and permanent reference this new research journal. The paper page size is  $5\frac{7}{8}$  by  $9\frac{1}{8}$  inches, and each volume (semiannual) will be indexed. A cumulative consolidated index will be included in the bureau's list of publications as heretofore.

The subscription rate is \$2.75 in the United States, Canada, Mexico, or Cuba, and \$3.50 per year for other countries.

The price of single copies is 25 cents domestic and 31 cents foreign. Remittances must be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C., NOT to the Bureau of Standards.

Shortly after each month's journal is published reprints of the separate articles contained may be purchased from the Superintendent of Documents.

#### PHYSICAL PROPERTIES OF HEAVY CLAYS

In connection with the heavy clay investigation being conducted at the Columbus branch of the bureau, a series of experiments was carried out to ascertain the pressures required to extrude the several shales and clays through dies. The pressure required to cause continuous flow of the material through a die of  $\frac{1}{2}$ -inch diameter was determined at four different percentages of tempering water for each of the shales and clays, the values being obtained for two different finenesses of grind; namely, as ground in a commercial 5-foot dry pan, and as ground in a ball mill for about 16 hours after dry panning. The data were plotted into curves from which the extrusion pressures could be obtained at the water concentration previously found to be necessary for properly tempering when the small auger machine was used. These values are shown in the following table.

Attention is called to the fact that the ball-milled shale samples required considerably more pressure than the commercially ground samples, the values averaging 117.9 and 25.9 lbs./in.<sup>2</sup>, respectively, when using the same percentages of water. This is to be expected, because with a marked increase in fineness of grain greater amounts of water are required for property tempering. In the case of the glacial and alluvial clays, the effect of ball milling was not very clear-cut because of the extreme fineness of these clays even when commercially ground. However, in general, a decrease in grain size is accompanied by a de-

crease in extrusion pressure when properly tempered, this being probably due to lessened friction. This is shown by the fact that even when using the same percentages of water, the average pressures for the commercially ground and ball milled glacial clays are 56.2 and 54.7, respectively. In the case of the alluvial clays, the average pressures for the commercially ground and ball milled samples are 85.1 and 82.4, respectively.

Slight variations in water content greatly affect the extrusion pressures. Thus, it is evident that in the industry great fluctuations in the power required for the pug mill and auger machine may be encountered by slight variations in the amount of tempering water employed and by the fineness of the grind. In general, alluvial clays require greater extrusion pressure than glacial clays, and shales require less than either of the clays, the average values being 90.5, 56.2, and 25.9 lbs./in.<sup>2</sup>, respectively.

| Kind of shale or clay         | Pressure per square inch required to extrude through a $\frac{1}{2}$ -inch diameter die |               |
|-------------------------------|---|---------------|
|                               | Commercial grind  | Ball milled   |
| <b>Shales:</b>                | <b>Pounds</b>   | <b>Pounds</b> |
| Allegheny, Malvern.....       | 31.2  | 262.0         |
| Conemaugh, Avon.....          | 15.0  | 199.0         |
| Allegheny, New Lexington..... | 20.0  | 76.5          |
| Waverly, Hanover.....         | 29.5  | 31.5          |
| Chagrin, Cleveland.....       | 17.0  | 41.2          |
| Waverly, Portsmouth.....      | 27.0  | 110.0         |
| Dunkard, Marietta.....        | 10.0  | 191.2         |
| Pottsville, Portsmouth.....   | 45.0  | 88.0          |
| Conemaugh, Summitville.....   | 13.0  | 83.7          |
| Bedford, Columbus.....        | 24.5  | 63.5          |
| Cincinnati, Cincinnati.....   | 52.5  | 150.5         |
| <b>Glacial:</b>               |   |               |
| Lima.....                     | 74.0  | 80.0          |
| Findlay.....                  | 46.2  | 48.0          |
| Upper Sandusky.....           | 72.5  | 91.2          |
| New London.....               | 56.7  | 53.0          |
| Mt. Healthy.....              | 23.2  | 19.0          |
| London.....                   | 51.2  | 48.5          |
| Toledo.....                   | 70.0  | 43.0          |
| <b>Alluvial:</b>              |   |               |
| Sugar Creek.....              | 41.5  | 40.5          |
| Westerville.....              | 75.0  | 75.2          |
| Beaver.....                   | 79.5  | 83.7          |
| Zanesville (loess).....       | 50.5  | 51.7          |
| Gallipolis.....               | 128.7   | 112.0         |
| Zanesville.....               | 135.7   | 122.5         |

NOTE.—Same amounts of water used for each clay or shale in commercial grind and ball milled.

# PHYSICAL PROPERTIES OF BODIES COMPOSED OF POTTER'S FLINT AND CLAY

The china clay investigation in progress at the Columbus branch of the bureau includes a study of the clays in bodies as well as a study of the clays alone. The composition of one set of bodies is 50 parts potter's flint and 50 parts clay, while the other is 50 parts clay, 30 potter's flint, and 20 feldspar. It is believed that the real reasons for the differences in the clays will be brought out more clearly by studying the reactions when in bodies as well as when treated individually. The general purpose of the investigation is to compare English and American china clays, but as yet only the English have been studied. Of these, 17 commercial brands are being used. During the past few months the work on the bodies composed of potter's flint and clay was carried out and is nearly completed.

Each of the clays was made up with an equal weight of potter's flint into a body, the size of specimens and procedure of making and testing following closely the specifications of the American Ceramic Society. The properties evaluated on the unfired bodies were those of volume shrinkage, shrinkage water, pore water, water of plasticity, bulk specific gravity, slaking time, and modulus of rupture. On the fired bodies values for volume shrinkage, porosity, bulk specific gravity, and modulus of rupture were determined at seven different temperatures; namely, cones 3, 5, 8, 11, 14, 18, and 23.

The various bodies have so nearly the same value for any one property that for the present purpose averages only are given. To show the effect of the flint, general averages for the clays alone are also given.

## Dry properties of clays and bodies

| Material         | Properties       |                 |            |                     |                       |               |                    |
|------------------|------------------|-----------------|------------|---------------------|-----------------------|---------------|--------------------|
|                  | Volume shrinkage | Shrinkage water | Pore water | Water of plasticity | Bulk specific gravity | Slacking time | Modulus of rupture |
|                  | Per cent         | Per cent        | Per cent   | Per cent            |                       | Hours         | Lbs./in.           |
| Clays alone..... | 18.6             | 11.6            | 29.8       | 41.3                | 1.46                  | 7.7           | 88.0               |
| Bodies.....      | 11.6             | 7.1             | 20.4       | 27.5                | 1.64                  | 6.6           | 46.6               |

## Fired properties of clays alone

| Property                         | Cone |      |       |       |       |       |       |
|----------------------------------|------|------|-------|-------|-------|-------|-------|
|                                  | 3    | 5    | 8     | 11    | 14    | 18    | 23    |
| Volume shrinkage.....per cent..  | 20.0 | 26.3 | 32.5  | 41.7  | 48.8  | 48.5  | 48.5  |
| Porosity.....do.....             | 40.3 | 35.9 | 29.0  | 17.5  | 3.9   | 1.2   | 1.0   |
| Bulk specific gravity.....       | 1.60 | 1.75 | 1.91  | 2.17  | 2.45  | 2.50  | 2.50  |
| Modulus of rupture.....lbs./in.. |      |      | 2,200 | 3,000 | 4,000 | 5,500 | 6,000 |

## Fired properties of bodies

| Property                                     | Cone |      |      |      |       |       |       |
|--|------|------|------|------|-------|-------|-------|
|  | 3    | 5    | 8    | 11   | 14    | 18    | 23    |
| Volume shrinkage.....per cent..              | 7.3  | 8.4  | 9.6  | 12.2 | 17.8  | 26.2  | 31.1  |
| Porosity.....do.....                         | 34.9 | 34.3 | 33.7 | 33.7 | 26.4  | 15.7  | 2.7   |
| Bulk specific gravity.....                   | 1.64 | 1.66 | 1.68 | 1.72 | 1.83  | 2.06  | 2.21  |
| Modulus of rupture.....lbs./in. <sup>2</sup> | 35   | 450  | 765  | 890  | 1,350 | 2,000 | 2,600 |

# THERMAL EXPANSION AND SPALLING CHARACTERISTICS OF FIRE BRICK

The most recent reference to the study of the fundamental qualities of representative fire-clay refractories and individual clays appeared in Technical News Bulletin No. 132 (April, 1928).

Bricks have been made in the laboratory, from prepared batch materials furnished by 14 manufacturers of refractories, by each of three methods most commonly employed in the manufacture of fire brick; namely, dry press, stiff mud extruded (end out), and hand made. These bricks were burned at 1,400° C. (cone 14) for five hours, and five of each type were subjected to the standard test for resistance to spalling as described in Bureau of Standards Circular No. 299, United States Government master specification for Fire-Clay Brick. This test specifies that the end face of the brick heated to 850° C. be immersed to a depth of 4 inches in running water at hourly intervals.

The results of the quenching test from a total of 42 sets of fire bricks, show (1) the number of quenchings to cause failure to range from 1 to 30; (2) those bricks, with one exception, whose alumina content is over 40 per cent, have considerably greater resistance to spalling than those whose alumina content is less than 40 per cent; (3) although some sets show little difference in spalling resistance between the bricks prepared by the different methods, others show almost 100 per cent difference.

Information has been furnished by the manufacturers as to their methods of making brick. The data thus obtained have been compared with that resulting from the bureau's brick-making experiments. This comparison shows that only six of the manufacturers are using methods which produce, from their particular raw batch, bricks having the greatest resistance to spalling.

The linear thermal expansion observations, which were made on 1 by 1 by 6 inch specimens of these bricks, gave the following information:

1. No relation is apparent between method of preparation of bricks and the thermal expansion.

2. In only one instance were the expansion measurements the same regardless of the method of making the bricks.

3. A direct relation was found between expansion and resistance to spalling in 7 out of the 14 sets observed for expansion; in 6 sets, 2 out of 3 show this relation; and in one case no relation was found, the results being identical for the 3 types of bricks.

4. The greatest difference in expansion between the bricks prepared by the three methods in any one set occurred in those of high silica content and amounted to approximately 10 per cent. The dry press had the highest expansion and the stiff mud the lowest.

## UNSLAKABLE RESIDUE IN QUICKLIME

Hydrated lime is produced from quicklime by treating quicklime with water in one of several different methods. The hydrate produced is usually in a very fine state of subdivision. However, to insure a uniformly fine product it is common practice to separate the fine material from the coarse by a process of air separation. Occasionally it is found that an undue amount of coarse residue is obtained. When the amount is large it represents a considerable loss to the producer of the lime, and it is consequently desirable to reduce the amount of residue to a minimum.

As it was considered of general interest and value to lime producers, the bureau has investigated the nature of unslakable residues. A sample of quicklime known to give considerable residue and a sample of the stone from which the quicklime was made were obtained. A weighed amount of the quicklime was added to a slight excess of water, stirred until slaking was complete, and then washed by decantation until the water ran clear. This process produced a residue which was dried in an oven at 110° C. and then weighed. It was found that the method gave about 5 per cent residue in the form of hard, gritty lumps,

the largest of which were approximately  $\frac{1}{8}$  inch in diameter. This was ground in a mortar until it passed a No. 200 sieve. It was then analyzed by the method outlined in Bureau of Standards Circular No. 204.

Samples of the stone and of the quicklime were also analyzed by the same methods.  $\text{SO}_2$  determinations were made on all three materials by the methods given in Bureau of Standards Circular No. 33. The following results were obtained. They have been calculated to the nonvolatile basis.

| Determination                | Stone | Quicklime | Residue |
|------------------------------|-------|-----------|---------|
| $\text{SiO}_2$ .....         | 0.97  | 1.00      | 3.08    |
| $\text{R}_2\text{O}_3$ ..... | .25   | .36       | .79     |
| $\text{CaO}$ .....           | 98.20 | 97.80     | 80.90   |
| $\text{MgO}$ .....           | .45   | .53       | 15.45   |
| $\text{SO}_2$ .....          | None. | Trace.    | Trace.  |

It is evident that the silica is somewhat concentrated in the residue. It is also evident that the greater part of the  $\text{MgO}$  from the stone has concentrated in the residue.

From the limited data it is impossible to draw any generalizations. It is hoped that future work on this subject may result in some conclusions which will be helpful in eliminating this undesirable waste in hydrated lime production.

#### LENGTH CHANGES IN SAND-LIME BRICK WHEN WET

The fact that most materials expand when wet and shrink when dry is suffi-

ciently well known to need no comment. The magnitude of this change, however, has not been measured in the case of many materials; as, for example, in sand-lime brick. While it has been assumed that the actual length changes on wetting or drying of brick are small, it was felt that some experimental data on these changes should be developed.

The Bureau of Standards has received a large number of sand-lime brick from various sources for use in an extensive investigation of the properties of these brick. Representative samples from five different localities were selected for measurement of the length changes on alternate wetting and drying.

Gauge marks were placed on each brick approximately 17 cm apart, and the increase or decrease in the distance between these marks was measured by a comparator which was graduated to 0.001 mm. The brick were put through the sequence of operations shown in the first column of the table. The length between the gauge marks on the air-dried brick was taken as unity and other lengths were calculated on this basis. Each figure is the average of four separate readings.

It will be noticed that the brick expanded on being immersed in water. On thoroughly drying they contracted to less than the original air dry length, and on subsequent treatments did not in any case return to the length when first wet.

*Length changes in sand-lime brick when wet*

| Source of brick                    | Relative lengths |         |         |         |         |
|------------------------------------|------------------|---------|---------|---------|---------|
|                                    | A                | B       | C       | D       | E       |
| Air dried.....                     | 1.00000          | 1.00000 | 1.00000 | 1.00000 | 1.00000 |
| In water for 48 hours.....         | 1.00010          | 1.00012 | 1.00009 | 1.00038 | 1.00008 |
| Air dried for 48 hours.....        | 1.00004          | 1.00005 | 1.00004 | 1.00029 | 1.00006 |
| Dried at 110° C. for 40 hours..... | .99978           | .99964  | .99973  | .99969  | .99992  |
| Boiled 5 hours.....                | 1.00004          | .99998  | 1.00001 | 1.00032 | 1.00007 |
| Air dried for 48 hours.....        | 1.00000          | .99996  | .99999  | 1.00022 | 1.00004 |
| Dried at 110° C. for 40 hours..... | .99972           | .99921  | .99962  | .99961  | .99982  |
| In water 28 hours.....             | .99998           | .99993  | .99996  | 1.00028 | 1.00001 |
| Air dried 24 hours.....            | .99996           | .99982  | .99994  | 1.00017 | .99997  |
| Dried at 110° C. for 40 hours..... | .99971           | .99923  | .99963  | .99965  | .99980  |
| Maximum change.....                | .00039           | .00091  | .00047  | .00077  | .00028  |

The magnitude of the changes was very small. The maximum change, case B, would only amount to about 0.1 inch in a 10-foot wall. This is sufficiently small to be neglected in most commercial work.

#### REMOVAL AND EXAMINATION OF SOIL-CORROSION SPECIMENS

The plans of the Bureau of Standards soil-corrosion investigation call for the removal of parts of the specimens at two-year intervals. In accordance with these plans the work of removing specimens of iron and steel pipe and lead cable sheath which have been buried for six years is well under way and will be completed during the present month. The specimens are returned to Washington, where they are cleaned and the rate of corrosion and pitting determined. The specimens are then photographed and stored. About 1,000 specimens will be removed this year. A report on the results of the 1928 examination will be available early next year.

The bureau recently issued its first report on its soil-corrosion work as Technologic Paper No. 368, Bureau of Standards Soil-Corrosion Studies. I Soils, Materials and Results of Early Observations. Owing to the demand for this publication the bureau's supply for official distribution has been exhausted, but it can be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 50 cents per copy.

This investigation was begun in 1922 as a supplement to the study of corrosion due to stray electric currents. It had become evident that in some cases where serious corrosion had occurred the cause of the corrosion could not be definitely determined until it was known whether such corrosion could occur in natural soils where no stray currents were present. The original investigation was, therefore, quite limited in its scope. The results obtained soon showed beyond question that corrosion of metal structures in soils was an extremely important problem in itself. Incidentally, some other tests have shown that the

processes of corrosion may include the production of rather large electric currents in pipe lines even when there are no extraneous sources of current.

A very wide interest has been manifested in soil corrosion, and many questions have been raised which can not be answered by the data which are being obtained. The work will not be finished for several years, but because of the interest manifested and the plans for corrosion studies that other organizations are considering it has seemed advisable to set forth in some detail the plans and scope of the bureau's investigation and to publish and discuss such data as are now available as a result of the investigation. The data indicate that in certain regions soil corrosion is an active enemy of buried pipe lines; that the material best suited to resist the action of one soil is not necessarily the best for other soil conditions; and that the use of some form of a protective coating is desirable under a number of soil conditions.

Because the rates of corrosion so far observed may not continue and because the rate for one material may change more than the rate for another, no conclusions can be drawn at this time as to the ultimate life of any of the materials under test nor of the relative merits of materials that are nearly alike. So far as observations on the materials are concerned, the report given in Technologic Paper No. 368 is therefore preliminary in its nature.

#### CALIBRATION OF ROTARY VISCOMETER

The general formula for computing viscosity, as determined by measuring the torque required to rotate a cylinder in a viscous liquid, contains a factor ( $k$ ) the so-called "end effect," which represents the amount by which the actual depth ( $h$ ) of immersion of the rotating cylinder in the liquid must be increased to evaluate the torque resulting from the friction of the viscous liquid on the lower end of the rotating cylinder. In a study of the constants of a rotary viscometer to be used in measuring the viscosities of molten glasses at various



temperatures, the variations of (k) with (1) depth (h) of immersion of the rotating cylinder, and (2) with the clearance (D) between the lower end of this cylinder and the bottom of the containing crucible were studied.

Using a mineral oil, the viscosity of which had been carefully determined by a different method, these relations have been determined for a viscometer with rotating cylinder 1.82 cm in diameter and outer cylinder 5.87 cm in diameter. For viscosities between 700 and 30,000 poises the variation of k with varying h was found to be negligible and the variation of k with D was found to be as follows:

|               |      |      |      |      |      |
|---------------|------|------|------|------|------|
| D -----cm---  | 1.58 | 3.00 | 4.65 | 5.78 | 8.26 |
| k-----do----- | 2.13 | 1.66 | 1.34 | 1.19 | 0.95 |

For these cylinder dimensions the relation of k to D can be expressed thus:

$$k = \frac{6.3}{(D + 2.426)^{0.8}}$$

It has also been shown that within the limits to be used in future work with glass k is independent of speed and viscosity.

#### PERMANENCE OF BOOK PAPERS

The Bureau of Standards has recently initiated, as a part of its general study of the permanence of paper, research on the permanence of book papers. This particular line of investigation was taken up for two reasons. One is to make certain that the paper used for the research publications of the bureau will have the desired permanence. The other is on account of the rapidly increasing interest, in general, in preservation of printed matter of permanent value. An illustration of this interest is the recent development, in which the bureau cooperated, of a newsprint paper made of rag fibers for printing special permanent issues of newspapers for libraries. Such issues are being made by a number of publishers. There is interest in a similar project, especially on the part of the American Library Association, for books and other bound printed matter.

The immediate work planned is the testing of products on the market at the present time. These will include complete chemical and physical tests to find the composition of the papers, accelerated aging tests made by exposure to heat and light, studies of the effect of the constituents of the papers on their permanence, and cooperative work with manufacturers to correct any properties of the papers that may be found undesirable from a permanence viewpoint.

#### PREMIUM GASOLINES

Gasolines sold at a premium over the ordinary or straight commercial gasoline may differ from it by being more volatile or by having less tendency to knock or detonate. Only those which are more volatile are entitled to be called "high-test" gasolines. High-test gasolines are of little advantage in warm weather, but in cold weather they give easier starting and less trouble from crank case oil dilution.

Gasolines which do not knock readily should be called high compression or "antiknock" gasolines. Antiknock gasolines include, in general, gasoline made from certain petroleum, gasolines made by certain refining processes, gasolines blended with benzol and ethyl gasolines (those containing tetraethyl lead). Engine tests at the bureau show that some of the nonpremium gasolines have much less tendency to knock than others, and that the various premium gasolines differ widely in their antiknock properties.

Unfortunately, there is at present no entirely satisfactory yard stick for comparing the tendency of gasolines to knock, so it is not practicable to include a knock requirement in fuel specifications. Many automobile engines of moderate compression ratio (less than 5:1) knock very little on nonpremium gasoline unless they contain excessive carbon deposits. In such an engine no improvement can be expected from the use of an antiknock gasoline. On the contrary, a fuel which knocks appreciably in a given engine will give less power

and less miles per gallon than one which does not knock.

#### THERMAL EXPANSION OF MAGNESIUM AND SOME OF ITS ALLOYS

An investigation on the linear thermal expansion of pure magnesium, magnesium-aluminum alloys, and magnesium-aluminum manganese alloys has recently been completed. Magnesium, the lightest structurally used metal, and its alloys, are becoming more prominent for materials of construction where lightness and strength are important factors; for example, in aircraft manufacture and for moving parts of gasoline engines.

Expansion determinations were made on 6 samples of cast and extruded magnesium and 11 samples of cast and extruded magnesium alloys. The samples of magnesium were investigated over various temperature ranges between  $-183$  and  $+500^{\circ}$  C. and most of the alloys between room temperature and  $300^{\circ}$  C. Three types of expansion apparatus were used in this investigation. The average coefficient of expansion of pure magnesium was found to be  $0.0000260$  per  $^{\circ}$  C. between  $20$  and  $100^{\circ}$  C.

The results obtained will be published by the Bureau of Standards. The publication will also include a summary of available data by previous observers on the thermal expansion of magnesium and a few magnesium alloys and a figure which shows the relations between the chemical composition and the coefficients of expansion of the magnesium alloys. Copies of the publication will be available in a few months.

#### PROPOSED AUTOMOTIVE STANDARDS

Forty new and revised standards for aircraft and motor vehicle parts and fittings are covered in reports submitted by divisions and subdivisions of the standards committee of the Society of Automotive Engineers. Eighteen of these relate to aeronautic standards, such as dimensions, weight, and other characteristics, aircraft storage batteries, propeller hubs, tail-skid shoe mountings,

engine starter countings, instrument mountings, and aircraft hardware.

Of the recommended new standards, 21 are new specifications and 17 are revisions of existing standards as printed in the S. A. E. Handbook.

Of most popular interest in connection with motor-vehicle standards are the proposed standardization of 16 balloon tire and rim sizes to greatly reduce the existing number, viscosity numbers for prediluted crankcases lubricating oils as well as undiluted oils, sizes of incandescent lamp bases and sockets to avoid too tight or too loose fits, air-cleaner mounting dimensions, spark-plug tolerances, and the plate-glass specifications covering the quality of the glass supplied to the car manufacturer.

#### RADIO AIDS TO AIR NAVIGATION

Research work extending over two years has resulted in the development and practical demonstration of radio aids to flying on the civil airways. These aids comprise a radio-beacon system marking out definite courses and radiotelephone service from ground to airplane. The whole system can be utilized by airplanes carrying no radio apparatus except a simple receiving set. This development, which was carried on by the Bureau of Standards for the Aeronautics Branch of the Department of Commerce, was briefly described in the Radio Service Bulletin, page 19; March 31, 1928. A technical description of the work, "Development of radio aids to air navigation," by J. H. Delling and Haraden Pratt, was published in the Proceedings of the Institute of Radio Engineers, page 890; July, 1928.

In the same issue of the Proceedings, page 985, there is given a "Bibliography on aircraft radio," by C. B. Joliffe and Elizabeth Zandonini. This bibliography includes 257 references to foreign and domestic periodicals.

Copies of these two reports are not available from the Government. A copy of the Proceedings of the Institute of Radio Engineers may be obtained from the institute at 33 West Thirty-ninth Street, New York, N. Y., for \$1.



A Pitcairn Mailwing airplane was put at the disposal of the bureau by Pitcairn Aviation (Inc.), for the installation of radio-receiving equipment including the visual indicator. This airplane is to be used later by this company in its regular air-mail service from New York to Atlanta, which passes through Washington, and will make use of the College Park beacon. This will give a test of the beacon system under actual conditions of use. The high-tension ignition system of this airplane was completely shielded, the leads from the magneto distributor blocks to the spark plugs were replaced by shielded high-tension cable drawn through the conduit manifold rings, shielding plates put over the magneto distributor blocks, and the spark plugs covered by special caps.

Several long flights were made by this airplane in order to test the radio installation on the plane and the operation of the beacon. On one flight a range of 90 miles was obtained through severe atmospheric disturbances. In another test working reed deflections were obtained at Hadley Field, New Brunswick, N. J., using the College Park beacon.

A new Fairchild cabin airplane having a capacity of four passengers was delivered and will be used for experimental work. Ignition shielding is being installed, and the airplane will be completely equipped with radio apparatus and will constitute a flying-radio laboratory.

#### INTERNATIONAL COMMISSION ON ILLUMINATION

The bureau is one of seven organizations represented in the United States National Committee of the International Commission on Illumination, the others being the American Gas Association, American Institute of Electrical Engineers, Illuminating Engineering Society, National Electric Light Association, American Physical Society, and the Optical Society of America. There are similar national committees in nine other countries—Austria, Belgium, France, Germany, Great Britain, Holland, Italy, Japan, and Switzerland.

Plans are now practically complete for the seventh plenary session of the commission. This will be the first meeting of the commission on this side of the Atlantic and is being made the occasion for an International Illumination Congress, including a tour for foreign delegates to New York, Boston, Philadelphia, Washington, Cleveland, Chicago, Detroit, and Niagara Falls, attendance at the annual convention of the Illuminating Engineering Society of the United States at Toronto, Canada, and special sessions of the commission at Saranac Inn, New York, September 22 to 27, 1928.

The bureau is particularly concerned with projects of the commission affecting standard methods of photometry, international standards of candlepower, specifications for colored signal glasses, and regulations for lighting of schools and factories. Reports on these subjects have been prepared for presentation at the commission sessions.

#### QUALIFICATION TESTING OF DRY CELLS

The bureau has recently begun a new qualification test of dry cells submitted by a number of different manufacturers. These tests are made periodically two or three times a year to obtain information required by Government purchasing officers as to the quality of dry cells which are available on the market and also as a measure of cooperation with the manufacturers.

The tests are made in accordance with Bulletin No. 36, issued by the Chief, Coordinator in June, 1924, in which a distinction is made between qualification tests and acceptance tests. The qualification tests are to determine the relative standing of the various brands of dry batteries when subjected to intermittent and delayed service tests in accordance with the specifications promulgated by the Federal Specifications Board. The specifications in effect at the present time are designated as United States Government master specification for dry cells and batteries (Bureau of Standards Circular No. 139). Intermittent

and delayed service tests require a considerable period of time, and there is no accurate method by which the output of the cells on these intermittent tests can be predicted from accelerated tests made in a short time. Acceptance tests, on the other hand, are designed to include only initial readings of current and voltage and continuous discharges which can be made immediately and compared with discharges made under similar conditions at the time of the qualification tests. The qualification tests give an indication of the true worth of the material and not of the ability of any particular cell or battery to pass a particular test which may have no relation to the service for which it is to be used. The acceptance tests, on the other hand, are designed to be made quickly on samples taken from actual deliveries. By means of these tests it is possible, therefore, to keep an up-to-date record of the quality of the batteries which are being manufactured and also to check the uniformity of the delivered product.

In the qualification tests that have just been started approximately 1,800 cells and batteries have been received from 19 manufacturers. The intermittent tests are controlled automatically by apparatus which was installed about two years ago. This apparatus enables tests of a large number of cells and batteries to be made with a minimum of labor and a consequent saving in expense as compared with the conditions which prevailed when a large number of batteries were under test during the war.

The results of the qualification tests are not published; they are, however, made available for the confidential use of Government officers, and each manufacturer is informed of the results of test on his own product. The bureau does not attempt to do general commercial testing for the battery manufacturers because its equipment is limited.

#### TESTING OF STANDARD WEIGHTS

Letter Circular No. 251, "Having standard weights tested by the Bureau of Standards," has just been issued, copies of which may be obtained on request to

the bureau. This letter circular gives in brief outline the main distinctions between weights of six different classes that may now be tested by this bureau, together with the nature of tests that may be made, and information in regard to submitting the weights for test.

#### REVISED SIMPLIFICATION FOR WOVEN WIRE FENCING

Simplified Practice Recommendation No. 9, "Woven Wire Fencing," which was recently revised by the industry, is now in effect, as of July 1, 1928, subject to annual revision.

Recently, this project was submitted to the industry for signed acceptances, in view of the proposed revisions. The bureau has received a sufficient number of signed acceptances from producers, distributors, and users, representing at least 80 per cent by volume of annual production, to publish the revised recommendation, copies of which may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

The original recommendation, as adopted by the industry, reduced the variety of woven wire fencing from 552 to 69 and woven wire fence packages from 2,072 to 138. The revised recommendation further reduced this to 62 and 117, respectively. At the time the project was reviewed by the standing committee and revised it was stated that the average degree of adherence accorded this recommendation in 1927, based on an actual survey, was 99 per cent.

#### SIMPLIFIED PRACTICE RECOMMENDATION FOR ICE-CAKE SIZES

The Bureau of Standards is now circularizing all elements of the ice industry—manufacturers, distributors, and engineers—interested for their acceptance of a simplified practice recommendation for ice-cake sizes.

This recommendation establishes a simplified list of weights for ice cakes for domestic refrigerators and dimensions for the ice cakes. The project was developed and approved by a general conference of all elements of the industry

held June 13, 1928. When indorsed by the industry, in the form of signed acceptance, representing at least 80 per cent of the industry by volume of annual production, it will be formally promulgated by the Department of Commerce.

Provided a sufficient number of signed acceptances are received, the recommendation will become effective October 1, 1928. While the action of the general conference of June 13 is based on a careful study of present conditions and requirements, the recommendation will be susceptible of such modifications as future trends in the industry may render desirable.

In order to make the schedule conform with the best current practice in the industry, the conference appointed a standing committee, to which the industry is urged to make any comments or suggestions that it is believed will make the recommendation more beneficial. Such action will help the committee arrive at a decision when considering possible revisions a year from the effective date.

#### BETTER QUALITY AND LOWER PRICE

The constant cry of the buyer from the early days of barter has been "better quality and lower price"—better value for the same or for less money. The problem of answering the buyer to his full satisfaction, under present conditions, is bothering many a manufacturer. No one solution to this problem applies in all cases; a choice may have to be made according to the nature of the business, but there's no use saying "It can't be done." There are too many examples of the man who says, "It can't be done," being interrupted by somebody doing it.

Scientific research is enabling manufacturers to improve the quality of materials entering into their products. It is also bringing out hitherto unknown or little understood properties of commonplace materials. New and substitute materials are coming to the front in several fields, often possessing certain advantages to the consumer over the materials they have displaced. Quality im-

provement through research is not new to American industry, but the steadily widening application of research reflects a growing appreciation of its value in bettering quality.

Simplification is likewise contributing to this end. Companies which have eliminated superfluous lines and concentrated their efforts on a simplified line find the quality of their products automatically improving. Defects, even minor faults, which in the days of too many lines, short runs, and frequent changes of machine set-ups, were overlooked or lost in the shuffle, assume greater proportions by reason of their greater numbers. The frequency of their occurrence may be no greater than before. The ratio may still be 10 "firsts" to one "second," or 100 "firsts" to one "second."

But when units are made by the thousand instead of by the hundred, then the "seconds" make a larger pile and attract more notice. Someone gets curious; somebody wants to know why the pile is so big. Then correction begins. Maybe better raw material is bought, more care is given it in process, perhaps the machines are improved. Eventually, the cause is located and the frequency of the defect is cut down. Product quality is improved as the result of simplification. So far as simplification has coincidentally helped to make mass production possible, and thus lower unit costs, it has made a double contribution.

By reducing "seconds," spoiled work, or scrap, and by lowering unit costs, simplification has provided the manufacturer with one answer, and a profitable one at that, to the buyers age-old cry, "Better quality and lower price."

#### PROGRESS IN SIMPLIFIED PRACTICE

During the quarter ending June 30, 1928, seven new simplified practice recommendations were completed, making a total of 95 completed recommendations to date. During the quarter 11 new leads were received by the division of simplified practice. There are now 39 active projects.

During the quarter the total number of acceptances to simplified practice recommendations increased from 9,465 to 10,637. Nine general and twenty-one preliminary conferences were held by various industries, under the auspices of the simplified practice division, for the purpose of discussing simplifications.

During this same period 5 general and 12 preliminary conferences were held under the auspices of the commercial standards unit.

A total of nine simplified practice recommendations came before their respective standing committees for review during the quarter ending June 30, 1928. Three were revised, five were reaffirmed, and one (Simplified Practice Recommendation No. 28, Sheet Steel) the standing committee deemed necessary to divide into two portions, to be published separately, one on sheet steel and the other on iron and steel roofing, the latter to be known as Recommendation No. 78.

Of the 9 recommendations reviewed 6 were supported by actual surveys, while estimates of adherence were accepted for 2, and 1 was reaffirmed without either a resurvey or estimate. The average degree of adherence as determined by surveys was 83.97 per cent for the six recommendations. The estimated adherence for the two without surveys was 80 and 89 per cent, respectively. Adding the 80 and 89 per cent to the 83.97, the average degree of adherence for the quarter was 84.32 per cent.

#### SOME RECENT ACTIVITIES OF THE COMMERCIAL STANDARDS GROUP

**Photographic Paper.**—A meeting of the simplified practice committee of manufacturers of photographic paper was held in New York on July 23 to consider the program for the simplification of photographic paper of various kinds which the committee has been developing for some time. It is expected that the final meeting of the committee will be held this month, when the schedule of sizes will be completed, in preparation for a general conference of all interests.

**Lead Pencils.**—The final schedule for the simplification of lead pencils has

been approved and will be placed before the industry for acceptance in the near future.

**Luggage.**—A member of the staff has been invited to address the Luggage Dealers Convention in New York City on August 17 on the subject "Standardizing luggage sizes." The National Luggage Dealers Association has worked out a suggested list of sizes for the consideration of the luggage industry covering trunks, suit cases, hatboxes, etc. It is the opinion of some that if the industry can arrive at a standardization of sizes it will be of great economic value to both the manufacturer and retailer.

**Ice Cream Cans.**—The Committee on Simplified Practice of the International Association of Ice Cream Manufacturers, in conjunction with representatives of ice-cream can manufacturing companies, met June 6, 1928, in New York City, to further the program of can standardization. A display of ice cream cans now being manufactured enabled the members of the committee to compare the different types and sizes of cans and determine upon tentative standard sizes. It was recommended that these sizes be submitted at the annual convention of the International Association of Ice Cream Manufacturers at Cleveland during the week of October 18 for consideration and criticism. When the standard-sized cans are finally adopted by manufacturers, distributors, and users, it will eliminate the confusion now existing because of the many types and sizes of cans on the market and will result in a lower-production cost.

**Glass Containers for Drug and Pharmaceutical Industry.**—At a preliminary conference of representatives of the drug and pharmaceutical industry and the Glass Container Association held July 6 a motion was presented and unanimously carried that a joint standardization and simplification committee be appointed to consist of one voting delegate and two associate delegates from each of the national drug and pharmaceutical associations and the Glass Container Association of America in cooperation with the United States Depart-

ment of Commerce, for coordinating the efforts of the various groups concerned in the simplification and standardization of glass containers used in the drug and pharmaceutical industries.

It was also the sense of the meeting that the appointment of the committee be completed as soon as possible with the view of holding its first meeting during the week of August 6 for the purpose of organization, and that this first meeting be held at the Department of Commerce under the auspices of the division of simplified practice.

In accordance with the action taken at the conference on July 6 the bureau invited 17 different drug and pharmaceutical associations and the Glass Container Association to send three delegates to a conference at the Department of Commerce on August 10, to complete organization of a central simplified practice committee and to discuss the question of variety surveys.

Glass Containers for Jelly and Preserves.—A general conference to discuss the simplification of jelly glass and preserve jar sizes and capacities has been postponed until some time in September. This conference will be held in Washington in conjunction with the mid-year convention of the National Preservers Association.

Type Faces.—For several months the United Typothetæ of America and the division of simplified practice have been cooperating in an effort to ascertain the views of leading printers and manufacturers of type as to the advisability of inaugurating a simplification program to reduce the excessive variety of type faces. While there are conflicting opinions regarding the matter, a large majority are, nevertheless, in favor of a conference to discuss the subject and to formulate some plans whereby the elimination of undesirable type faces might be brought about. At the request of the United Typothetæ of America, the division of simplified practice will arrange for a preliminary conference in the fall to consider the subject of simplification of type faces. In the meantime the division will be glad to receive any com-

ments or suggestions which the readers of this bulletin may care to express on this subject.

Hospital Plumbing Fixtures.—A tentative simplified-practice recommendation for hospital plumbing fixtures has been worked out by the manufacturers of vitreous china, porcelain, and enameled fixtures. This recommendation is now in the hands of the standardization committee of the American Hospital Association for review and further recommendation as to definite types and sizes to be used as standard items for various purposes. After the hospital authorities have compiled their criticisms and comments there will be a joint meeting of the hospital plumbing fixture manufacturers and members of the standardization and simplification committee of the Hospital Association to develop a final recommendation covering types, sizes, dimensions, etc.

#### CAST IRON FOR ENAMELING PURPOSES

It was stated in the preceding item on this subject (Technical News Bulletin No. 130, February, 1928) that when the surface layer was removed from the blistering irons which had been studied they no longer caused blisters in an applied vitreous enamel. With this fact in mind, further work has been done to obtain results which might facilitate the identification of the major source of blisters.

Nonblistering castings, even when obviously poorly sand blasted, remained nonblistering, a fact which led to the conclusion that this iron did not contain any blister-producing material at its surface. (An alternate possibility was that it might have contained such material, which was more easily removed by sand blasting than in the case of a blistering casting.)

Samples taken from the surface and interior, respectively, of castings which blistered before, but not after, removal of a surface layer were examined spectroscopically. No difference was observed.

A white cast iron, not meant for enameling, was enameled under various firing

conditions, but always blistered severely, whether the surface was removed or not. An extended annealing or graphitizing treatment, which completely changed the character of this iron, rendered it possible to enamel it with beautiful results when proper firing conditions were used. Any considerable variation from the optimum firing treatment, however, would result in the appearance of blisters. Specimens of a nonblistering iron were then cast against a chill to produce white iron. This treatment was not conductive to any considerable amount of blistering in the iron tested. The same iron cast in molds having abnormally low, normal, and abnormally high moisture content retained in all cases its nonblistering tendencies.

#### RATING COMMERCIAL AUTOMOBILES

The Bureau of Standards receives numerous inquiries for its rating of particular makes of automobile as regards quality of materials, workmanship, or performance which indicate that some automobile salesmen are claiming to have bureau test data on certain makes of commercial automobiles. In particular, it has been reported recently that the bureau made comparative tests of cars or engines representing competing makes of moderate-priced automobile.

It is not the policy of this bureau (1) to make routine tests of automobiles or automobile engines, (2) to undertake comparative tests of commercial automobiles or automobile engines unless for official purposes, or (3) to make public test data on any commercial automobile, automobile engine, or automobile accessory.

The Bureau of Standards has used available automobiles as equipment for the investigation of such problems as skidding, brake performance, riding quality, and headlighting. It has also used commercial automobile engines as laboratory apparatus for the study of problems connected with motor fuels and motor lubricants as well as problems of ignition and cooling. General tests of the performance of a particular

make and model of engine or motor vehicle are only undertaken when required for the information of the Government.

#### VAPOR LOCK IN AIRPLANE FUEL SYSTEMS

Experience in the altitude chamber of the Bureau of Standards indicates that occasional engine failures and more frequent erratic performance of airplane engines are caused by the permanent or temporary interruption of normal fuel flow due to the formation of gas bubbles in the carburetor jet or elsewhere in the fuel system. This difficulty is known as "vapor lock" and is most likely to occur with fuels containing an excess of the more volatile constituents or of dissolved gases.

The provision in the present aviation gasoline specifications which says that the 5 per cent point on the American Society for Testing Materials distillation curve shall not be lower than 50° C. (122° F.) was placed there as a protection against vapor lock. It is believed, however, that this particular limitation on the volatility of aviation gasoline excludes some gasolines which are not likely to cause vapor lock and admits others which are liable to cause vapor lock.

A study of aviation gasolines is now in progress at the bureau, with the object of developing means of distinguishing between fuels which are suitable for use in airplane engines and those which are unsuitable from the point of view of possible difficulty from vapor lock.

#### EFFECT OF RELATIVE HUMIDITY AND TEMPERATURE UPON THE PHYSICAL PROPERTIES OF VULCANIZED RUBBER COMPOUNDS

The work of the Physical Testing Committee, rubber division, American Chemical Society, carried on at the bureau during the last year, in which the effect of temperature and humidity upon the stress-strain relation, both subsequent and prior to vulcanization, was investigated, will soon be published in *Industrial and Engineering Chemistry*.



Several thousand tests were made covering a range of relative humidity from 0 to 100 per cent and a range of temperature from 5 to 45° C. These ranges were covered with 5 compounds and each compound was represented by a range of 5 cures.

The work is now being extended with three of the compounds used previously and an additional one which simulates a commercial heel compound, in a study of resistance to abrasion. This resistance to abrasion is being determined over a range of temperatures and humidities. The investigation is only partially completed, but it has been found that a difference of 20° C. may cause a 25 per cent change in resistance to abrasion. This difference due to temperature varies both in degree and kind with the compound used.

Measurements of resistance to abrasion are being made in each case with two machines of quite different types. The Grasselli instrument, which works on the Prony brake principle, gives results in volume abraded against an emery paper, per horsepower hour, while the United States machine records the volume abraded per hour by a wheel bound with emery cloth, with no power measurements taken.

#### NEW PUBLICATIONS<sup>1</sup>

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1927).

##### Journal of Research<sup>1</sup>

Bureau of Standards Journal of Research, July, 1928, Vol. 1, No. 1. (See announcement in text of this issue of the Technical News Bulletin.)

##### Scientific Papers<sup>1</sup>

Title page and index for volume 22 of Scientific Papers, Nos. 547 to 572, inclusive (free on application to Bureau of Standards).

<sup>1</sup> Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscriptions to Technical News Bulletin, 25 cents per year (United States, Canada, and Mexico), 40 cents (foreign).

#### Circulars<sup>1</sup>

C360. United States Government master specification for integral waterproofing material (for use with Portland cement mortar or concrete). Price, 5 cents.

C363. United States Government master specification for packing, flax. Price, 5 cents.

Simplified Practice Recommendations<sup>1</sup>  
(Elimination of Waste)

SPR73. One-piece porcelain insulators. Price, 5 cents.

#### Miscellaneous Publications<sup>1</sup>

M84. Standard time conversion chart. (Movable disk mounted on heavy cardboard, size 8 by 10½ inches.) Price, 10 cents.

#### Technical News Bulletin<sup>1</sup>

TNB136. Technical News Bulletin, August, 1928.

#### OUTSIDE PUBLICATIONS<sup>2</sup>

On the Geiger counter. L. F. Curtiss; Physical Review (Corning, N. Y.), Vol. 31, p. 1060; June, 1928.

The Zeeman effect on the hyperfine structure of mercury 2537. W. A. MacNair; Physical Review (Corning, N. Y.), Vol. 31, p. 986; June, 1928.

A projection electroscope for standardizing radium preparations. L. F. Curtiss; Journal of the Optical Society of America and Review of Scientific Instruments (Ithaca, N. Y.), Vol. 16, p. 363; May, 1928.

A new design of apparatus for the moving-boundary method of determining transference numbers. Edgar Reynolds Smith; Journal, American Chemical Society (Easton, Pa.), Vol. 50, p. 1904; July, 1928.

Rotatory power and structure of the sugar group. Part 18. Alpha-methyl d-lyxoside triacetate. F. P. Phelps and C. S. Hudson; Journal, American Chemical Society (Easton, Pa.), Vol. 50, p. 2049; 1928.

<sup>2</sup> "Outside publications" are not for distribution or sale by the Government. Request should be sent direct to publishers.

- Development of radio aids to air navigation. J. H. Dellinger and Haraden Pratt; Proceedings, Institute of Radio Engineers (New York, N. Y.), Vol. 16, No. 7, p. 890; July, 1928.
- Bibliography on aircraft radio. C. B. Joliffe and Elizabeth Zandonini; Proceedings, Institute of Radio Engineers (New York, N. Y.), Vol. 16, No. 7, p. 985; July, 1928.
- Dew points of air-gasoline mixtures from distillation curves. Oscar C. Bridgeman; Journal, Industrial and Engineering Chemistry (Washington, D. C.), Vol. 20, No. 8, pp. 821-826; August, 1928.
- The influence of fuel characteristics on engine acceleration. Donald B. Brooks; Preprint of paper delivered before semiannual meeting, Society of Automotive Engineers (New York, N. Y.), June, 1928.
- An automatic sample-collecting vacuum pump. E. R. Weaver and G. M. Shepherd; Journal, American Chemical Society (Easton, Pa.), Vol. 50, p. 1829; July 6, 1928.
- Cement as a factor in the workability of concrete. P. H. Bates and J. R. Dwyer; Proceedings, American Concrete Institute (Detroit, Mich.), Vol. XXIV, p. 43; 1928.
- Notes on the progress of some studies on crazing of Portland cement mortars. P. H. Bates and C. H. Jumper; Proceedings, American Concrete Institute (Detroit, Mich.), Vol. XXIV, p. 179; 1928.
- Discussion of fatigue studies of telephone cable sheath, by Townsend. H. L. Whittemore; Proceedings, American Society for Testing Materials (Philadelphia, Pa.), Vol. 27, 1927, Part II, Technical Papers, p. 169.
- Discussion: Tension testing of thin sheet metal, by Templin. H. L. Whittemore; Proceedings, American Society for Testing Materials (Philadelphia, Pa.), Vol. 27, 1927, Part II, Technical Papers, p. 256.
- Control for welding. H. L. Whittemore; Journal, American Welding Society (New York, N. Y.), Vol. 7, No. 6, p. 52; June 6, 1928.
- The seasonal variation in the fire loss. Ruth L. Morgan; American Journal of Insurance (Chicago, Ill.), Jan. 1928, p. 13.

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